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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/707,905	01/23/2004	Douglas D. Coolbaugh	BUR920030177US1	1904

7590 07/24/2006

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EXAMINER

HU, SHOUXIANG

ART UNIT PAPER NUMBER

2811

DATE MAILED: 07/24/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/707,905	COOLBAUGH ET AL.	
	Examiner	Art Unit	
	Shouxiang Hu	2811	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 09 May 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 16-29 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 16-29 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Objections

1. Claims 16-29 are objected to because of the following informalities and/or defects:

Claims 16, 24 and 29 recite the terms of "lower region", "middle region" and "upper region", but fails to clarify the positional relationship between these regions, such as whether or not they overlap with each other; and, according to the specification, these regions have to overlap with each other in the active region in order for the recited varactor to be operative.

Claims 17, 19 and 20 each recite the term(s) of "further comprising forming (or doping)", but fails to clarify the their relationship with the actions of "doping" already recited in claim 16. For example, the term of "forming a cathode" recited in claim 17 should be included in the action of "doping a lower region" recited in claim 16.

Claim 29 recites the terms of "collector region" and "cathode region", but fails to clarify their relationship with the "lower region" and/or the "middle region" also recited in the claim.

Appropriate correction is required.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the

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art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claim 28 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Claim 28 as amended recites the subject matter of "only three doping steps are utilized to form the varactor with a cathode, a collector, an HA junction and an anode", but full support for them are not found in the original disclosure. A varactor inherently includes doped contact region(s), such as the contact region 48 and/or 59 in Figs. 2 and 3 of the instant invention; otherwise the varactor would not be operative. And, the formation of such contact region(s) naturally involves further doping step(s). In fact, according to the original specification (Paragraphs 0048 and 048), only the active region of the varactor, rather than the varactor itself, may be formed with only three doping steps.

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claim 28 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claim 28 as amended recites the subject matter of "only three doping steps are utilized to form the varactor with a cathode, a collector, an HA junction and an anode", but fails to clarify the relationship between the "three doping steps" and

the terms of "doping" recited in claim 16. And, it is not definitely clear what are the "three doping steps" and which one is associated with which of the formations of the recited terms of cathode, collector, HA junction and anode.

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 16-18 and 24-29, insofar as being in compliance with 35 U.S.C. 112 and as being best understood in view of the claim objections above, are rejected under 35 U.S.C. 102(b) as being anticipated by Igarashi (Igarashi et al., JP 4-343479, 11/30/1992).

Igarashi discloses a method of fabricating a varactor (especially see Figs.1 and 2, also see the English abstract), wherein the remaining n-type region 6 (under the p-type region 7) comprises: a first region--the lowest region of the region 6; a second region--the low region of the region 6 that is above and in contact with the lowest region; and, a third region---an upper region of the region 6 that is above the second region (the low region) but below and in contact with the p-type-doped region 7. The method comprises: doping a lower region (the first region of 6) of a substrate layer with a first type of dopants having a dopant profile such that first-energy ("A") atoms therein penetrate to a first depth ("A' ") in the substrate layer, which naturally forms a cathode

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as it is n-type doped in the diode structure, and with a second-energy atoms ("B") therein penetrate to a second depth ("B' ") in the substrate layer forming a collector region (the second region of the region 6) above the cathode, wherein naturally $A > B$ and $A' > B'$, as they are formed of a same type of implanted dopants, and the second region of the region 6 can naturally function as a collector region as it is formed of an n-type doped region near the PN junction of the diode structure; doping a middle region (the third region of the region 6) of the substrate layer with a second type of dopants, which is naturally tailored (super-abrupt type) for a to-be-implant profile that forms the anode as it is in direct contact with the to-be-formed anode region (7); and, doping an upper region (7) of the substrate layer that is naturally with a source/drain-type implantation to form the anode region (7) of the diode structure, wherein the doping of the upper region (7; about 40 keV) has less energy than that the other regions (inside region 6; around 70 keV).

Regarding claims 25 and 29, the forming of the collector region and the cathode in Igarashi are naturally formed in a single doping step via a naturally existing energy distribution of a single type of dopants.

Regarding claim 26, the active portion of the varactor in Igarashi can be naturally regarded as being formed in a column from the substrate which is semiconductor material.

Regarding claim 28, insofar as being in compliance with 35 U.S.C. 112, the dopings of the active regions in Igarashi can be regarded as being consisted of three doping steps with two of them are implemented simultaneously.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 19-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Igarashi in view of AAPA (Applicant admitted prior art).

The disclosure of Igarashi is discussed as applied to claims 16-18 and 24-29 above.

Although Igarashi does not expressly disclose that the method can further comprise the process/steps of forming a bottom layer of the low region with a higher doping concentration, an isolating region, a reach-through implant, and/or a silicide layer, one of ordinary skill in the art would readily recognize that such process/steps are each common in the art for forming desired buried interconnection and/or desired element isolation structure and/or contact to the collector region with reduced connection resistance, as readily evidenced in the prior art, such as AAPA (see the highly doped bottom region 14, the isolation 18, the reach-through region 20, and or, the silicide layer 34).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate process/steps of forming the highly doped bottom layer, isolating region, reach-through implant, and/or silicide layer into the method of Igarashi, per the teachings of AAPA, so that a method for forming a varactor

with desired element interconnection, element isolation and/or reduced connection resistance to the collector region would be obtained.

Regarding claims 19 and 20, it is further noted it is art known that a same type dopant can be used for deep and/or shallow implantations for better control of doping profiles; and that higher energy is always required for deeper implantation for the same type dopant.

Response to Arguments

6. Applicant's arguments filed on May 9, 2006 have been fully considered but they are not persuasive.

With respect to applicant's arguments that Igarashi does not disclose the invention as defined in claims 16 and 24, it is noted that the implantation processes of Igarashi, naturally meet that of the claimed invention, because: (A) each of the resulting regions in Igarashi naturally functions respectively as that recited in the claimed invention; (B) the implanted regions in the remaining n-type region (i.e., the lower and middle regions) can be naturally regarded as being consisted of the identified first, second and third regions in the remaining region of 6 (i.e., the remaining portion of 6 that underlies the p-type doped region 7, as identified in the claim rejections set forth above in this office action), and naturally have different dopant depths along the vertical direction, corresponding to the naturally existing energy distribution of the same n-type dopants implanted into the remaining n-type region, wherein dopants in deeper depth naturally possesses higher implanting energy compared to that of the same type

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dopants but stopped at less deep depths, otherwise all of the same n-type dopants would be stopped at exactly a same depth; and, (C) the p-type doping for the upper region (i.e., for region 7) in Igarashi is naturally a source/drain-type implantation at a substantially shallow depth (with a doping energy of about 40 keV that is substantially lower than the average doping energy for the remaining n-type region of about 70 keV). Accordingly, in Igarashi, the energies for the doping the various regions naturally follow the following order from high to low:

- the naturally functional cathode region;

- the naturally functional collector region;

- the middle region; and,

- the upper region,

corresponding to their depths from deep to shallow.

Furthermore, it is noted that applicant's arguments lack sufficient evidence to show why the doping processes of Igarashi would not naturally result in the dopings as recited in claims 16 and 24.

Applicant's arguments appear to imply that the doping processes of Igarashi do not meet the claimed dopings because the doping processes in Igarashi does match with the doping steps in the instant invention and their implicated sequence. However, what recited in claims 16 and 24 are the actions of dopings, without specific steps and orders being defined for them in the claims. And, any two or more actions of dopings can be regarded as a single action of doping if they can be performed simultaneously; or, vice versa. In this case, the doping for the remaining n-type regions can be naturally

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regarded as comprising the recited dopings of the recited lower and upper regions, as the claimed invention such as the one in claims 16 and 24 lacks sufficient limitations to specifically define the sequential relationship(s) between the actions of the recited dopings. Applicant is reminded that, although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

Regarding applicant's request for a full translation of the recited Japanese patent (4-343479), the examiner has submitted a request for such full translation, which is expected to be completed in two weeks and will be FAXed to applicant upon its completion.

Regarding the obviousness rejection, in response to applicant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). And, in response to applicant's argument that there is no suggestion to combine the references, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, Igarashi discloses the claimed invention including the recited

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dopings for the active region, except the formations of the bottom layer of the low region with a higher doping concentration, an isolating region, a reach-through implant, and/or a silicide layer. AAPA is cited to show that the ordinary skill in the art would readily recognize that such formation processes are each common in the art for forming the commonly desired and/or required features including the buried interconnection, element isolation structure and contact to the collector region with reduced connection resistance, regardless whatever specific steps of doping with whatever doping energies are taken for the formations of the active regions, as each of these formed features has its own specific required and/or desired functionality in a varactor.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Shouxiang Hu whose telephone number is 571-272-1654. The examiner can normally be reached on Monday through Thursday, 7:30 AM to 6:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie C. Lee can be reached on 571-272-1732. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

SH
July 20, 2006



SHOUXIANG HU
PRIMARY EXAMINER